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This report contains abstracts of formal scientific reports and news items on Soviet research in the earth sciences, including meteorology, oceanology, and geophysics. Information on current Arctic and Antarctic expeditions is also provided.

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USSR REPORT
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CONTENTS

METEOROLOGY

ELECTROMAGNETIC FIELD OF A POWERFUL VERTICAL THERMAL CURRENT

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 872-874 manuscript submitted 9 Apr 79

KONOPASOV, N. G., KUNIN, V. N., PLESHIVTSEV, V. S., Vladimirskiy Polytechnic Institute

[Abstract] Currents can be created by the energy released in fuel combustion. The fuel combustion processes are accompanied by intensive ionization of the combustion products and the turbulent nature of the flame and the current itself should lead to charge separation and the formation of electric fields. The presence of such a current in the atmospheric surface layer should exert an effect on the earth's electric field. An experiment for clarifying the nature of such an effect was carried out at the experimental base of the Physics Department at Vladimirskiy Polytechnic Institute. A vertical thermal current was created by an apparatus with a thermal power of 100 MW. The current reached a height of 250-300 m and at a height of 100 m its diameter was about 60 m. Variations of the earth's electric field in the extremely low-frequency radio range were registered in four reception channels. The use of four channels with different frequency characteristics makes it possible to judge variations of the earth's electric field in a broader frequency range and have a better idea concerning their spectral characteristics. The antenna for the first channel, situated at a height of 15 m at a distance of 30 m from the apparatus, in its operation was in the immediate neighborhood of the current; the antenna for the second channel was at a distance of 50 m from the apparatus; for the third channel -- 90 m; fourth channel -- 140 m. It is shown that at short distances the thermal current causes an increase in dispersion of variations of the earth's electric field. Changes in the earth's electromagnetic field by a vertical thermal current can be attributed to at least three mechanisms: 1) the current is a region of existence of uncompensated electric charges whose concentration experiences temporal changes in time and space; 2) distortion of the earth's field as a result of the difference in conductivities and dielectric constants of the current and surrounding air; 3) influence of the current on local meteorological conditions and the presence of correlations between them and variations of the electric field in the extremely low-frequency range. Figures 4; references: 5 Russian.
[18-5303]

UDC 551.466(38+8)

EFFECT OF SURFACE-ACTIVE SUBSTANCE FILMS ON CHANGES IN WIND WAVE SPECTRA UNDER INFLUENCE OF INTERNAL WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 10, 1980 pp 1068-1076 manuscript received 2 Jul 79, after revision 10 Dec 79

YERMAKOV, S. A., PELINOVSKIY, Ye. N., TALIPOVA, T. G., Institute of Applied Physics

[Abstract] The mechanism of formation of slicks of surface-active substances is examined in detail in relation to the influence of internal waves. Using basically the data published by N. L. Jarvis, et al. (J. MARINE RES., No 1-2, 1969), the authors analyze the attenuating properties of such sea films. It is shown that within the limits of the transition region there is a sharp increase in the attenuation coefficient of waves in the centimeter range to maximum values. It was also found that disturbances in the concentration of surface-active substances are proportional to displacement of the level of the main mode of the internal wave. In the case of waves observed under natural conditions these disturbances are of the order of magnitude of the transition regions of isotherms of sea films, as a result of which, with satisfaction of stipulated conditions, the decrement over the bottom of the wave increases sharply. It was possible to obtain the necessary condition for the formation of slicks associated with a film of surface-active substances; this is confirmed by the work of Jarvis, et al. The variability of the wave spectra can be computed on the basis of a linear model of wind waves and the results of computations of the redistribution of the decrement in the field of the internal wave. Figures 4; references 27: 13 Russian, 14 Western.
[24-5303]

UDC 551.466.8:551.465.63

THERMAL EFFECT OF INTERNAL GRAVITATIONAL WAVES AT THE FREE SURFACE OF THE OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 10, 1980 pp 1077-1081 manuscript submitted 2 Aug 79

VOLKOV, Yu. A., KUFTARKOV, Yu. M., Institute of Atmospheric Physics USSR Academy of Sciences and Marine Hydrophysical Institute Ukrainian Academy of Sciences

[Abstract] The article describes an experiment carried out within the framework of the international JASIN-78 program. The objective of this experiment was clarification of the interrelationship between internal waves of the seasonal thermocline and temperature fluctuations at the free surface of the ocean. The authors give the results of observations made on the 18th voyage of the scientific research vessel "Akademik Vernadskiy" in September-October 1978 in the North Atlantic. Measurements of the parameters of internal gravitational waves were made using distributed temperature sensors. In the analysis use was made of data from an eight-hour measurement interval during the evening and nighttime, as being the most favorable for observation of the radiation temperature of the ocean surface. Observations of temperature of the ocean surface were made using an IR radiometer from aboard a ship. The data collected in the course of this experiment indicated that the stability of the phase shift and the high coherence level in periods from 35 to 15 minutes reveals an interrelationship between the temperature of the ocean surface and the field of internal waves of the upper thermocline. The statistical analysis presented in the paper makes it possible to assume that making use of the IR thermal radiation of the free surface of the ocean it is possible to make a remote investigation of internal gravitational waves of the seasonal thermocline. Figures 4, tables 1; references: 1 Russian, 4 Western.
[24-5303]

AERIAL METHODS FOR STUDY OF THE OCEAN AND ITS FLOOR

Leningrad PROBLEMY ISSLEDOVANIYA I OSVOYENIYA MIROVOGO OKEANA in Russian 1979 pp 135-165 signed to press 30 Oct 79

SHARKOV, V. V.

[Abstract] The possibilities of different aerial methods in study and special mapping of the oceans are still far from clear. However, it is clear that the improvement of existing aerial methods and the development of new ones (such as laser, UV and geochemical surveys) will considerably enhance the effectiveness of study of the ocean and will make it possible to solve many scientific and practical problems in oceanology, as is made clear in this state-of-the-art review. The author begins with a classification of such aerial methods, the comparative characteristics of which are summarized in Table 1. One section of the article is devoted to the materials used in photographic, television and scanner aerial surveys; information is given on films, spectral ranges, scales, etc. This is followed by a discussion of the interpretation of aerial images of the water surface, features and phenomena in its deeper layers; among the subjects covered are: sea waves, sea currents,

water color, spirallike Langmuir circulations, internal waves, plankton and turbid water. Also examined is the problem of interpretation of features on the sea floor, with consideration of such subjects as geological-geomorphological study and mapping, geological engineering work, search for underwater minerals, vegetation and compilation of sea charts. The collection of information on features of the sea floor on the basis of indirect criteria includes use of indicators of submarine volcanic eruptions, indicators of underwater mud volcano eruptions, indicators of discharge of underground fresh, thermal and juvenile water, indicators of possible deposits of petroleum and gas, indicators of bottom relief forms, the latter including such phenomena as waves, the breaking of waves, wave refraction, upwellings and turbid water. The characteristics of IR aerial surveys are covered in detail, followed by presentation of similar material on radar, laser, luminescent and ultraviolet surveys. Aerogeochemical and aerogeophysical (aeromagnetic and aerogravimetric) surveys of the ocean are also reviewed. Figures 8, tables 1; references 19: 16 Russian, 3 Western.
[28-5303]

MAN'S HABITATION OF THE SEA DEPTHS: LIFE SUPPORT SYSTEMS

Leningrad PROBLEMY ISSLEDOVANIYA I OSVOYENIYA MIROVOGO OKEANA in Russian 1979 pp 391-403 signed to press 30 Oct 79

BOROVIKOV, P. A.

[Abstract] At present man's presence underwater is limited to weeks, possibly months, no more. Engineers and physicians concerned with this matter of habitation of the sea must successively solve three interrelated problems, which are fully discussed in this article: man's underwater preservation of life, health and performance. The author begins his treatment of these matters with a review of the properties of the water medium with which man must contend. This is followed by a discussion of the two methods now employed for carrying out underwater work: total isolation from the surrounding water and prolonged, multiday confinement under pressure. Pressure chambers of various kinds, diving bells and individual diving gear are considered. The requirements for life support in each of these systems are analyzed in detail. The life support systems described in the article are responsible for processing of the breathing mixture, eliminating carbon dioxide and anthropotoxins from it, adding oxygen, and maintaining temperature and moisture content of this mixture within the necessary limits. The most important task in this field at the present time is the maximum expansion of the volume of fundamental investigations of diving and underwater physiology. The following aspects of the problem are examined at the greatest length: pressure of breathing mixture, monitoring of composition of the breathing mixture and its maintenance in stipulated limits, measurement of breathing mixture temperature and moisture content, devices for purification of the breathing mixture, regulation of breathing mixture moisture content. Other problems in underwater work which need solution or improvement are: sanitary facilities, maintenance of acoustic communications, underwater heating of a diver, rendering assistance to sick or injured underwater workers. Divers are now descending as deep as 500 meters; laboratory modeling shows that a depth of 600 meters is entirely feasible; it is clear that 600-800 or even 1,000 meters is not impossible.
[28-5303]

UDC 551.482.214

EFFECTS OF PRECIPITATION IN OCEAN SURFACE LAYER

Moscow OKEANOLOGIYA in Russian Vol 20, No 5, 1980 pp 828-836 submitted for publication 19 Jul 79, after revision 18 Oct 79

GINZBURG, A.I., ZATSEPIN, A. G., SKLYAROV, V. Ye., FEDOROV, K. N., Institute of Oceanology

[Abstract] Precipitation is rarely taken into account when formulating models of energy exchange between the ocean and the atmosphere; this is also true of models of the structure of the upper layer in the ocean. However, the authors have felt that the changes in the thermohaline structure and disruption of ordinary conditions of heat exchange in the ocean-atmosphere system caused by precipitation can evidently have major energy consequences which have nowhere been discussed in the literature. Accordingly, in this study the authors have employed measurements made on the 27th voyage of the scientific research vessel "Akademik Kurchatov" in an investigation of the characteristics of the horizontal and vertical thermohaline structure of the upper ocean layer associated with the falling of precipitation. The measurements revealed that when there are relatively weak winds showers with a duration of 1-2 hours and with an intensity of 20 mm/hour or more during the time of the falling can freshen a thin (to 1 mm thickness) layer near the ocean surface by 0.5-1°/oo, which considerably exceeds the usual local variability of salinity in the upper layer in the absence of rain. Brief, lighter showers reduced salinity near the surface by 0.2-0.3°/oo. The physical processes participating in the formation and evolution of the thermohaline "traces" of rain in the upper layer of the ocean and the influence of these "traces" on heat exchange with the atmosphere are discussed. Figures 4; references 14: 6 Russian, 8 Western.
[19-5303]

UDC 551.46:551.55

COMPUTATIONS OF DRAG COEFFICIENT AND WIND STRESS AT OCEAN SURFACE

Moscow OKEANOLOGIYA in Russian Vol 20, No 5, 1980 pp 837-843 submitted for publication 24 Dec 79, after revision 14 Apr 80

DIKINOV, Kh. Zh., ZHOLUDEV, V. D., Kabardino-Balkarskiy State University, Nal'chik

[Abstract] Standard meteorological data for weather station "P" for the two-year period 1972-1973 were used in computing the drag coefficient and wind stress at the ocean surface. The methods employed in this work are based on similarity theory for the near-water layer of the atmosphere. The processed data reveal that the drag coefficient, whose magnitude is influenced by stratification effects, varies linearly with wind velocity in conformity to the law $10^3 C_{10} = 0.79 + 0.089 W_{10}$ for the wind interval 3-19 $m \cdot sec^{-1}$. In the case of weak and moderate winds the wind stress varies proportionally to the square of wind velocity, whereas for stronger winds it varies as W_{10}^3. The results are in good agreement with the results of

other researchers, especially a study by K. L. Denman and M. Miyake (JGR, Vol 78, No 12, 1973), whose authors used observational data for this same weather station, although for other observation times. Figures 4; references 13: 6 Russian, 7 Western.
[19-5303]

UDC 551.46.087

TOWED MEASUREMENT COMPLEX FOR STUDYING VARIABILITY OF INTEGRAL TEMPERATURE OF THE UPPER LAYER IN THE OCEAN

Moscow OKEANOLOGIYA in Russian Vol 20, No 5, 1980 pp 937-942 submitted for publication 22 Aug 79

PARAMONOV, A. N., GREKOV, N. A., IVANOV, A. F., Marine Hydrophysical Institute Ukrainian Academy of Sciences

[Abstract] Using experience accumulated by the Marine Hydrophysical Institute in the development and operation of towed instrumentation at sea, on the 17th voyage of the scientific research vessel "Akademik Vernadskiy" the specialists of the automation detachment tested a method developed for a unit which measures integral temperature $\bar{T}$ for investigations of the surface layer of the ocean while the ship is moving on course. The studies were made using the towed "Shleyf" complex; its towing method and structural diagram are illustrated in Fig. 1. The complex consists of submergible and on-board units. The submergible part includes primary converters of integral $\bar{T}$, surface T_0 and deep T_{deep} temperatures and also a primary converter of pressure with depth P_{deep} at the end of the distributed temperature sensor. In addition to the primary converters T_{deep} and P_{deep}, the hermetically sealed capsule of the submergible unit houses a temperature-frequency converter and channel commutator, alternately sending into the communication channel information on deep temperature and pressure. The principal technical specifications of the towed complex are:
-- response of unit for measuring integral temperature ($\Delta\bar{T}$) — 0.02°C;
-- response of unit for measuring surface temperature (ΔT_0) — 0.005°C;
-- response of unit for measuring deep temperature (ΔT_{deep}) — 0.005°C;
— time constant of unit for measuring integral temperature (τ) -- 16 sec;
-- time constant of unit for measuring deep temperature (τ_{deep}) — 18 sec;
-- time constant of surface temperature (τ_0) — 3 sec;
-- working length of distributed primary temperature converter (L) -- 3,000 m;
-- depth of towed end with ship's speed of 15 knots — 220 m;
-- accuracy in determining depth -- ±1 m.
The simplicity of the electrical and mechanical construction of the "Shleyf" complex and its high reliability in operation under complex weather conditions and in different climatic zones made it possible during the 17th and 18th voyages of the "Akademik Vernadskiy" to carry out extensive investigations of the upper layer of the ocean over a route of more than 15,000 km, representing 750 hours of continuous observations. The good results of these investigations indicate that a complex of the "Shleyf" type should be introduced on scientific research ships. Figures 4; references: 5 Russian.
[19-5303]

SYSTEMS FOR CONTROL OF INDUSTRIAL ROBOT COMPLEXES

Leningrad PROBLEMY ISSLEDOVANIYA I OSVOYENIYA MIROVOGO OKEANA in Russian 1979 pp 343-359 signed to press 30 Oct 79

POPOV, Ye. P.

[Abstract] The enormous problems involved in mastery of the world ocean cannot be solved using the simple robots and manipulators now employed. More universal, multipurpose industrial robot manipulation complexes with unmanned working apparatus, controlled by a combined man-computer system, are badly needed. This review article discusses master, slave and semiautomatic systems. In the case of the latter there are three principal control methods: speed, force and position (and combinations of these). All three types of remote control systems (master, slave, semiautomatic) can be classified as "biotechnical" because the operator, watching the screen and instruments for monitoring the motion of the manipulator and the conditions in its neighborhood, constantly transmits control signals. Human hands at all times direct the actions of the manipulator. It is obvious that the effectiveness of operations of an underwater manipulation robot will increase if some of these functions are performed in an automatic regime. Figure 7 in the text is a functional diagram of an automated control system; Figure 10 is a functional diagram of a so-called "supervisor" control system (in which all the individual elements of the operation are programmed); Figure 11 is a functional diagram of a "dialogue" control system (with the fullest form of interaction between a digital computer and a man-operator). These different variants of improved robot-manipulator control are considered in detail. Among the many systems examined in the article the most promising are the automated, "supervisor" and "dialogue" interactive control systems, supplemented by biotechnical systems with a control lever and special computer. Figures 13; references 8: 7 Russian, 1 Western.
[28-5303]

UDC 551.463.2

SOUND-SCATTERING LAYERS IN THE OCEAN (REVIEW)

Moscow OKEANOLOGIYA in Russian Vol 20, No 5, 1980 pp 793-805 submitted for publication 19 March 1980

ZHITKOVSKIY, Yu. Yu., MOZGOVOY, V. A., Institute of Oceanology

[Abstract] Making full use of the available literature (74 sources are cited), the authors present a review of experimental investigations of the characteristics of sound-scattering layers in the ocean published during the period 1975-1979. The following aspects of the problem are considered: research methods, frequency of measurements, geographic regions of measurements (summarized in a table), principal characteristics of layers, variability, migration, comparison of results of acoustic investigations of sound-scattering layers with catch data, identification of scatterers, influence of surrounding conditions on behavior of sound-scattering layers, regionalization of world ocean on the basis of the acoustic properties of sound-scattering layers. The use of acoustic methods for investigating these layers can make a substantial contribution to solution of the following problems: study

of the spatial (geographic, deep) and temporal distribution of scattering organisms, remote classification and identification of organisms, study of the behavior of organisms (swimming, reaction to stimuli, migration), quantitative estimates of biomass, estimates of effectiveness of trawls, direct and indirect observations of physical and chemical phenomena (turbulence, eddies, internal waves, gradients of water density and temperature, fronts, etc.). It is clear that the solution of these problems requires close cooperation among specialists in acoustics, biologists, physicists and chemists. There is a need for much more nonacoustic information on the behavior of organisms, their physical properties, reactions to different external stimuli and conditions in the ocean, as well as species composition in different regions of the ocean. Figures 4, tables 1; references 74: 13 Russian, 61 Western.
[19-5303]

UDC 551.463(265/266)

THERMODYNAMIC LONG-PERIOD OSCILLATIONS OF OCEAN AND ATMOSPHERE IN NORTHERN PART OF PACIFIC OCEAN

Moscow OKEANOLOGIYA in Russian Vol 20, No 5, 1980 pp 818-827 submitted for publication 19 May 80

VOLKOV, Yu. N., USSR Hydrometeorological Center, Moscow

[Abstract] Employing a simple thermodynamic model of interaction between the ocean and the atmosphere, the author examines the following feedback: 1) the intensity of atmospheric circulation is determined by meridional contrasts of the water temperature anomaly in the region of an ocean front; 2) a wind change causes anomalies in current velocity and the heat flow at the ocean surface; 3) these factors lead to a change in water temperature anomalies, which in turn changes the wind velocity. The materials presented in this paper show that as a result of such interaction long-period oscillations appear in the thermodynamic characteristics of the ocean and atmosphere. A physical explanation is given for the macroscale nature of water temperature anomalies and the nonuniform rate of their movement along ocean circulations. The model used in formulating these findings is a simplified version of that developed earlier by V. G. Kort (OKEANOLOGIYA, Vol 10, No 2, pp 222-239, 1970). The generating mechanism of interaction between the ocean and atmosphere is the dependence of the intensity of atmospheric circulation on the temperature gradient in the region of the ocean subpolar front, which in turn determines the anomalous nature of the transport of temperature fluctuations by currents along ocean circulations. Figures 3, tables 2; references 17: 12 Russian, 5 Western.
[19-5303]

UDC 551.465

HORIZONTAL NONUNIFORMITY OF WATERS IN RED SEA DEPRESSIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 254, No 2, 1980 pp 483-486 submitted for publication 1 Apr 80

MONIN, A. S., corresponding member USSR Academy of Sciences, PLAKHIN, Ye. A., PROKHOROV, V. I., Institute of Oceanology

[Abstract] Investigations in the depressions of the Red Sea rift carried out in the winter of 1979-1980 revealed a substantially more complex stratification of hot brines than was assumed earlier on the basis of sporadic discrete observations. The first information was obtained on the horizontal nonuniformity of hydrophysical fields in depressions. A hydrophysical survey of the depressions with a precise sounding apparatus indicated a considerable increase in the temperature of brines in the Atlantis-II depression in a north-to-south direction; this can be evidence of an outpouring of hot waters from a source situated in the southern parts of the depression. An analysis of the T(Z) profiles in three depressions in the Red Sea rift and a detailed bathymetric map of this region failed to confirm the hypothesis of water exchange between the basins. Evidently each of the studied basins has (or had) its own source of thermal waters, although this hypothesis also requires experimental checking. Figures 2, tables 2; references 5: 2 Russian, 3 Western.
[30-5303]

UDC 550.373

EMERGENCE OF THE MAGNETIC FIELD INDUCED BY SEA CURRENTS FROM THE WATER LAYER INTO THE ATMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 20, No 5, 1980 pp 905-911 submitted for publication 22 Jan 79

ZHMUR, V. V., Institute of Oceanology

[Abstract] The problem examined in this article is the nature of emergence of the magnetic field induced by sea currents from a water layer into the atmosphere. If such a field emerges it can be registered by a magnetometer installed on the shore. In turn, the emerging field can create noise during magnetotelluric sounding. Measurements made by the author in the Caspian Sea in 1977-1978 indicated that if a magnetic field does emerge from the water into the atmosphere its value is insignificant. Theoretical studies have shown that the field from horizontal currents is concentrated in the conducting layer. Therefore, the emergence of the field from currents in which vertical velocity is absent into the atmosphere can be associated with horizontal nonuniformity of the conductivity of sediments. Two independent problems are considered in this article. An examination of the first indicates that for a linear nonstationary current of arbitrary structure the induced magnetic field is in the conducting region if the medium is uniform along the current vector; all the parameters of the problem (bottom profile, other discontinuities, conductivity, velocity) can have any dependence on the coordinates

perpendicular to the current. The second problem, which is solved here, was obtaining a solution for the strength of the induced magnetic field in a medium anisotropic in the direction of the current. The general conclusion is drawn that a nonuniformity of conductivity of bottom sediments in the direction of a current leads in fact to emergence of the induced field into the atmosphere. The real field strength in the atmosphere can amount to several nT. Figures 4; references 5: 3 Russian, 2 Western.
[21-5303]

UDC 551.466.31

ASYMPTOTIC BEHAVIOR OF WAVE MOVEMENTS AT SURFACE OF A FLUID

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 874-876 manuscript submitted 21 May 79

MIRCHINA, N. R., PELINOVSKIY, Ye. N., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] An asymptotic (self-similar) solution for gravitational waves on the surface of a fluid of infinite depth, caused by an initial disturbance localized in a small region, is well known. From the physical point of view this solution describes only a precursor of wave motion since the amplitude of the wave is not limited in the region of the initial disturbance at any moment in time. In order to describe the main part of the wave it is necessary to dispense with use of assumptions in the theory, such as the total self-similarity of wave movement. This article describes the asymptotic behavior of wave movements in media with a power law of dispersion $\omega = \beta k^{\alpha}$ (ω is frequency, k is the wave number, α and β are constants), special cases of which are gravitational ($\alpha = 1/2$) and capillary ($\alpha = 3/2$) waves in a fluid of infinite depth and capillary waves in shallow water ($\alpha = 2$). It is shown that with $\alpha < 2$ the asymptotic form of the wave has the form of a quasimonochromatic packet whose amplitude is inversely proportional to distance and is not dependent on α, whereas the length of the wave is determined by the magnitude of the initial disturbance. With $\alpha > 2$ the disturbance is dispersed and the field maximum always remains in the initial region. References 7: 5 Russian, 2 Western.
[18-5303]

TERRESTRIAL GEOPHYSICS

SOVIET SCIENTISTS MAKE EARTHQUAKE PREDICTIONS

Moscow STROITEL'NAYA GAZETA in Russian 15 Dec 78 p 4

[Article by Vl. Akhlomov]

[Text] How can an earthquake be predicted? An answer to this question is being sought by seismologists in many countries of the world. STROITEL'NAYA GAZETA has more than once told about the successes of Soviet scientists in solving this highly complex problem. Specialists of the Institute of Physics of the Earth USSR Academy of Sciences in collaboration with the personnel of other seismological agencies for the first time in history have made an attempt at a trial routine prediction of earthquakes.

They selected the region carefully and some time was required. They finally decided on Kamchatka. It was very familiar to scientists. It was precisely there, more than two decades ago, that the Pacific Ocean Expedition, organized by S. A. Fedotov, now Corresponding Member USSR Academy of Sciences, Director of the Institute of Volcanology, began its research, seeking a better understanding of the dynamics of physical processes in the earth's crust. And in general, for such investigations there is no better region than Kamchatka: it is an excellent scientific polygon.

Prediction methods based on a detailed study of precursors are being developed for determining the time of a future earthquake. Highly sensitive electronic instruments are used in registering and discriminating precursors from extraneous "noise," for example, of a meteorological nature, or the effect of ocean surf in the coastal regions. Quite a few precursor phenomena are known, but unfortunately each of them separately does not yield reliable information. And for practical purposes it is important to know more than that an earthquake will occur. It is considerably more important to determine in what specific place and when precisely (with an accuracy to several days, and better still -- hours) the catastrophe can be expected.

Doctor of Physical and Mathematical Sciences G. Sobolev, in collaboration with S. Fedotov, has developed a special program for the test routine scientific prediction of an earthquake. And now, here on Kamchatka, a multidiscipline seismological expedition had to check the program to see if it was realistic.

As a basis a study was made of three different types of precursors. Elastic waves moving through the earth's crust were registered prior to strong tremors. As was noted before, there were displacements in the crust, fracturing of rocks, and the velocity of wave propagation changed. Wave propagation was also monitored. It was

established that prior to a seismic catastrophe it is common to observe a surprising "silence" -- an almost complete absence of weak tremors. Finally, earth currents were registered: their strength changes on the eve of crustal movements.

Although the expedition was outfitted, as they say, with the last word in technology, scientists nevertheless decided initially to issue a forecast not only on the basis of instrument readings, but also on the basis of expert evaluations. The group of researchers, monitoring a definite precursor, on the basis of its behavior expressed their point of view concerning the possibility of an underground cataclysm in one region or another. Then the individual evaluations were summarized and carefully analyzed.

In one of the regions with increased tectonic activity the group headed by G. Sobolev discovered a strong electric field. It was appreciably stronger than in quiet zones. The curve of changes was found to bend sharply and on the eve of powerful underground tremors it "veered" sharply. The stronger was the earthquake which followed, the sharper was the veering of this curve prior to the event.

And more than a few such discoveries were made in the two years of the investigations.

"We were convinced on the basis of our own experience," says Gennadiy Aleksandrovich Sobolev, laboratory head at the Institute of Physics of the Earth, "that in principle a routine scientific prediction of earthquakes is possible. A group of scientists of our institute and the Institute of Volcanology succeeded in predicting them two or three days in advance. It is even possible to determine the epicentral region with an accuracy to 100-150 km."

"Does that mean in actual practice?"

"Unfortunately, for the time being, no. The reliability of the prediction is still inadequate for practical purposes. On Kamchatka the accuracy was about 70%, but a minimum of 95% is necessary. Accordingly, the research is continuing."

After Kamchatka the scientific experiment was continued in Central Asia. Scientists of the Institute of Physics of the Earth, in collaboration with researchers of the Tadzhik Institute of Seismology, in the Dushanbe and Garm regions, under the direction of one of the most experienced Soviet seismologists, I. L. Nersesov, have carried out a routine prediction using nine types of precursors. These included changes in the resistivity of rocks, changes in the earth's magnetic field, monitoring of weak seismicity, monitoring the velocity of elastic waves, and registry of the deformation and tilting of the earth's surface.

"Also here, in the Central Asia region, in two cases scientists have successfully predicted earthquakes," says Gennadiy Aleksandrovich. "A test scientific prediction has also been initiated in the Kurile Islands. There, to be sure, only one method is used and analyzed: observations are being made of the fluctuations of water level in boreholes. The fact is that it changes in dependence on the stresses in rocks. And if there are many boreholes and these are frequently monitored, it is possible to ascertain the region of the strongest variations of water level and on the basis of this criterion determine the zone in which an earthquake may be unleashed. An

experimental prediction was rather precise. Incidentally, this is also confirmed by an experiment which in collaboration with our scientists is being carried out by specialists of the Seismology Institute Uzbek Academy of Sciences. They recently rather successfully predicted the time of occurrence of an earthquake. It occurred, as is well known, on 1 November. Several days prior to the event the outpouring of water from the experimental boreholes ceased unexpectedly in the prediction polygon. The seismic calm was replaced by weak tremors which the instruments registered. On 1 November it was predicted that an earthquake would occur in the next few hours to the south of Andizhan, in the South Tien Shan zone. It actually occurred after six hours."

This means that the time is approaching when special seismic services, cognizant of the danger of a catastrophe, will warn: "An earthquake will occur tomorrow!"

An extensive national program of seismic research is now being developed under the direction of Academicians M. Sadovskiy and A. Sidorenko. It provides for a complex of automated stations which will make observations of precursors of "underground storms" in Central Asia, the Far East, Siberia and especially along the Baykal-Amur Railroad, where permanent seismic stations are to be set up. They will continuously register changes in processes in the earth's crust making use of not less than 10 geophysical parameters. All these data will be processed by computer. Intensive laboratory model experiments with special high-pressure apparatus are continuing at the Institute of Physics of the Earth, at seismic agencies of the union republics, in the Siberian Division and at the Far Eastern Scientific Center USSR Academy of Sciences and study of the nature of earthquakes is continuing.

In short, the time of precise prediction is approaching.
[8144/0339-5303]

5303
CSO: 8144/0339

UDC 550.341(575.3)

DYNAMICS OF DEVELOPMENT OF REGIONS OF SEISMIC QUIET AND PREDICTION OF STRONG EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 10, 1980 pp 12-22
submitted for publication 24 Mar 80

MIKHAYLOVA, R. S., Institute of Seismic Resistant Construction and Seismology, Academy of Sciences Tadzhik SSR

[Abstract] A study was made of the patterns of formation of the region of seismic quiet prior to strong earthquakes. The period of observations used was from 1955 through 1977-1979. The analysis included all earthquakes with $K \geqslant 10$. All data were broken down into four major seismogenic zones located in the territory of Tadzhikistan and adjacent regions. It was found that regions of seismic quiet prior to strong earthquakes (K = 15-16) are formed gradually, increasing in extent due to the migration of earthquakes informative on the basis of calm behavior ($K \geqslant 11$-12) in the direction from the epicenter of a future tremor. The rate of migration varies from 6 to 19 km per year. The expansion of zones of quiet is nonuniform in time: with the approach of a main earthquake the process is slowed down. A characteristic "spatial-temporal bay" is formed as a result. The regions of seismic calms preceding strong earthquakes following one another in time and situated close together can overlap but the focal zones do not overlap. Within a region of seismic quiet there is sometimes an increase in the activity of weaker earthquakes which migrate from the region of preparation or from the margin of a future focal zone in the direction of the epicenter of the main tremor. The most probable position of the focal zone of a strong earthquake, including the epicenter of the main tremor and its aftershocks, is in the region of the minimum of the "spatial-temporal bay" of the seismic calm, in the direction away from the anticipated seismicity. Figures 7, tables 1; references: 16 Russian.
[23-5303]

UDC 550.34.016

VELOCITY OF PROPAGATION OF SHEAR DISPLACEMENT ALONG PRE-EXISTING FISSURE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 10, 1980 pp 23-31 submitted for publication 15 Oct 79

SHAMINA, O. G., PAVLOV, A. A., Institute of Physics of the Earth USSR Academy of Sciences

[Abstract] An experimental study was made of the velocity V of propagation of a shear displacement along a pre-existing fissure in a two-dimensional case. It was possible to ascertain the regularities of its behavior for a linear fault in dependence on stresses in the medium and the momentary length of the fault. It was found that V in the final stage of displacement can attain values close to the velocity V_P, but as a result of the low V value in the initial stage the mean velocity of propagation of such a fault does not exceed V_S (V_P and V_S are the velocities of longitudinal and transverse waves in the material of the model). The model used in the work was described in detail in earlier publications. The investigations revealed that the dynamics of fault propagation is characterized by nonlinear regularities: the nonlinearity is manifested both in the dependence of the current velocity of propagation of the fault on its length and the velocity of displacement on the stresses operative in the fault. The magnitude of the stresses in the medium at which displacement occurs is naturally related to the intensity of all the frictional force in the fault. Displacement becomes possible when the external force operative in the fault exceeds the frictional force between its sides. Figures 6; references 13: 6 Russian, 7 Western.
[23-5303]

UDC 550.34

ROUTINE PREDICTION OF STRONG EARTHQUAKES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 254, No 2, 1980 pp 325-327 submitted for publication 24 Jun 80

ZENKOV, V. S., KALINNIKOV, I. I., NYUNIN, M. I., Institute of Physics of the Earth USSR Academy of Sciences

[Abstract] Earthquake prognostic criteria can be classified as long-range and routine. It is usually assumed that the latter criteria are manifested only in the near zone. For the practical realization of routine prediction and the use of observations in the distant teleseismic zone for this purpose it is necessary to answer the following questions (which are dealt with in this paper): what is the mechanism of focal development on the eve of the main faulting which ensures the possibility of routine prediction? what requirements must be met by an instrument used in predicting a distant earthquake? is it possible to predict local earthquakes, and if so, how? These questions are answered on the basis of a series of postulates which the authors feel are not contradicted by any known facts. 1) Several hours prior to the main faulting at the focus of the future earthquake there is an ordered (in a statistical sense) system of fissures whose extent corresponds to the length of the future fault, and accordingly, the energy of the future

earthquake. 2) If an earthquake should occur, such an ordered system of fissures is in a subcritical state, that is, an external effect of sufficiently great intensity or a dropoff of strength with time under the influence of a load will lead to an earthquake. 3) The ordered system of fissures in a subcritical state ("prefault") under the influence of weak external disturbances, and also as a result of a continuing "ordering" process, is excited and oscillates as a single whole, emitting seismic energy at maximum periods. The high-frequency part of the energy is absorbed in the volume of the focus itself and in its neighborhood. 4) The amplitude, duration and frequency of occurrence of oscillations of the "prefault" increases with an increase in the criticality of state. The energy of oscillations of the "prefault" is drawn from the energy of unordered (in the statistical sense) small fissures. 5) Emission of seismic energy by the "prefault" leads to a further decrease in its temperature, that is, to an increase in the "ordering" and a decrease in the strength of rocks, and this leads to the main faulting. On the basis of these postulates it is concluded that the prognostic apparatus must be oriented on a fine spectral analysis of seismic and microseismic waves. For routine prediction in the near zone ways must be found to extract information on the preparation of strong earthquakes from the coda of local earthquakes, whereas for routine prediction in the distant teleseismic zone ways must be found to discriminate individual random events whose spectral makeup corresponds to the proposed system of postulates. The authors contend that since the prediction of an earthquake is accomplished on the basis of the energy criterion it is obvious that the site of a future earthquake can be determined by methods well developed in seismology. It is also stated that the intensity of a future earthquake can be determined with ease by using the formula which they present. References: 12 Russian.
[30-5303]

UDC 551.24:550.34.06

SEISMOTECTONIC CONDITIONS FOR OCCURRENCE OF GAZLIY EARTHQUAKES OF 1976

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1980 pp 12-28
submitted for publication 4 Dec 79

KRESTNIKOV, V. I., BELOUSOV, T. P., SHTANGE, D. V., Institute of Physics of the Earth USSR Academy of Sciences

[Abstract] Two strong earthquakes with M = 7.0 and 7.3 occurred in April and May 1976 in the Kyzylkum desert, the tremors occurring in a region earlier considered virtually aseismic. A comparison of these earthquakes with the geological structure of the region shows that their epicenters were not associated with known dislocations developing in the Neogene and especially in the Quaternary. This makes it possible to assume that the occurrence of earthquakes was associated with a newly forming latent fault zone in the crystalline basement not manifested at the earth's surface. Such an assumption does not contradict the nature of the tectonic development of the Central Kyzylkum and this is confirmed by seismological data — the high-frequency spectrum of oscillations. A study of the areal distribution of the aftershocks of the Gazliy earthquakes made it possible to evaluate the parameters of the postulated fault. Its strike is close to latitudinal with a

northward dip of 75-80°. The mechanisms of earthquake foci and repeated levelings carried out after earthquakes indicated that the northern part of the epicentral zone was uplifted relative to the southern part. The relatively great width of the region of aftershocks and the noncorrespondence of the focal mechanisms of the earthquakes, determined on the basis of seismological data, to the general geological conditions indicate a complexity of the structure of the fault zone, the development of a considerable number of dislocations making it up. Therefore, the zone of the postulated fault with which the Gazliy earthquakes may be associated in its structure and conditions of formation is a typical Tien Shan feature and its occurrence was the result of the entire course of Quaternary and recent geological development of the Central Kyzylkum. Figures 5; references 30: 29 Russian, 1 Western.
[22-5303]

UDC 550.312

EVALUATIONS OF POSSIBLE CHANGES IN ELEMENTS OF THE EARTH'S GRAVITY FIELD WITH TIME

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1980 pp 70-77
submitted for publication 17 Feb 76

VORONTSOVA, Ye. A., KUZIVANOV, V. A., MEDVEDEVA, N. S., NAUMENKO-BONDARENKO, I. I., STEPANOVA, M. B., Institute of Physics of the Earth USSR Academy of Sciences

[Abstract] The authors employed models in determining the possible changes in elements of the gravity field which can be caused by different processes transpiring at the earth's surface, in the lithosphere and mantle. The authors feel that from both physical and geological points of view it is entirely sound to postulate that variations in elements of the gravity field with time can be caused by combined vertical and horizontal movements of the earth's crust and individual parts of the lithosphere, changes in volume, form and density of masses in the lithosphere and mantle (especially in the asthenosphere). A series of models is presented. These models make it clear that recent crustal movements, arched uplifts, etc. can be causes of changes in elements of the earth's gravity field. These changes are evidently insignificant and therefore are very difficult to measure. They usually have a low-frequency character, which introduces additional difficulties in measuring these variations. In order to detect and study these variations it is necessary to increase the accuracy of gravimeter and variometer measurements by 2 or 3 orders of magnitude. In this case new possibilities are afforded for using the results of measurements of nontidal variations of gravity field elements for the purpose of analysis of tectonic, dynamic and thermodynamic processes in the crust, lithosphere, asthenosphere and mantle. Figures 6; references 14: 11 Russian, 3 Western.
[22-5303]

UDC 550.343

LONG-RANGE PRECURSORS OF A SERIES OF STRONG EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1980 pp 110-117
submitted for publication 8 Jan 80

KULAGIN, V. K., MALAMUD, A. S., STARKOV, V. I., KULAGINA, M. V., Institute of Seismic-Resistant Construction and Seismology Tajik Academy of Sciences

[Abstract] It was found that there is a good correlation between long-range changes in the rate of deformations of the earth's crust (measured at one or two points), ratios of the velocities of longitudinal and transverse waves, slopes of the frequency of recurrence and total number of earthquakes arising in different volumes of the earth's crust and in the upper mantle. During a period of increase in the rate of deformation of the earth's crust there is an increase in the total number of earthquakes at all depths, a decrease in the ratio of velocities V_P/V_S and a decrease in the slope of the curve of frequency of recurrence of crustal earthquakes. The already established fact of an increase in the slope of the curve of frequency of recurrence of deep-focus earthquakes with an increase in the rate of deformation can be explained on the assumption that the matter in the upper mantle is in a special physical state characterized by a strong inverse dependence of relaxation time on stress. The characteristic persistent anomalies noted in the long-range variation of all the analyzed precursors do not precede a single large event, as is usually assumed, but a whole series of strong earthquakes whose foci are spatially separated by great distances. The seismic calm observed immediately before this series coincides in time with the most intensive change in the considered parameters. It appears that in order to find precursors prior to each individual strong earthquake it is necessary to study fluctuations of the parameters relative to their long-range variation. Figures 6; references 16: 14 Russian, 2 Western.
[22-5303]

UDC 550.344

QUASIHARMONIC SIGNAL FROM NUREKSKAYA HYDROELECTRIC POWER STATION IN THE GARM POLYGON

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1980 pp 118-128
submitted for publication 9 Sep 78

TROITSKIY, P. A., Institute of Physics of the Earth, USSR Academy of Sciences

[Abstract] An attempt was made to discriminate a narrow-band signal from microseismic noise. The postulated signal source was the Nurekskaya hydroelectric power station. The analyzed records of microseismic noise were registered near Chusal station (one of the stations in the Garm polygon) at a distance of about 120 km from the source. The results of the study can be used in the orientation of studies directed to investigation of the earth's structure using artificial sources of seismic oscillations. It was found that the spectrum of microseisms included frequencies close to the frequency of rotation of the turbine at the Nurekskaya hydroelectric power station. It was discovered that at distances of about 100 km from the source, emitting seismic energy of about tenths of a watt at a frequency of about 3 Hz, it was possible to accumulate and discriminate a signal against a noise background. The estimate of the seismic energy emitted by the source is about 10^3 J. Figures 7, tables 3; references 12: 10 Russian, 2 Western.
[22-5303]

UDC 550.348

SPATIAL-TEMPORAL CHARACTERISTICS OF FOCI OF STRONG EARTHQUAKES WITH DIFFERENT TYPES OF DISPLACEMENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 9, 1980 pp 3-11
submitted for publication 3 Nov 79

KOPNICHEV, Yu. F., SHPIL'KER, G. L., Institute of Physics of the Earth, USSR Academy of Sciences

[Abstract] On the basis of an analysis of data in the literature (57 sources are cited) it was possible to ascertain the correlation between focal extent L_0 and magnitude M and also to estimate the mean velocities of fracturing v for earthquakes with different mechanisms. The results presented here indicate that there is a strong dependence of focal dimensions and fracturing velocity on the type of earthquake mechanism, which agrees with both the different spatial-temporal characteristics of the foci and the peculiarities of the wave fields generated by them. It therefore follows that the focal mechanism is a very important parameter which must be taken into account in detailed seismic regionalization and also in the modeling of strong movement. It is shown here that many known geophysical-geological data, such as the dependence of the width of the fault zones on the type of displacement and the correlation between the extent of the foci and seismic activity, as well as the characteristics of incoherent radiation of strong earthquakes with different mechanisms, agree well with the results. Figures 3, Tables 2; references 57: 17 Russian, 40 Western.
[22-5303]

TIMELY PROBLEMS IN SEISMIC PROSPECTING AND WAYS TO SOLVE THEM

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 7, 1980 pp 19-28

ALEKSEYEV, A. S., corresponding member USSR Academy of Sciences

[Abstract] A number of new problems have arisen before the geological prospecting of new deposits, especially in Siberia and the Far East. It is now necessary to study nonstandard forms of bedding of deposits under conditions of a complex geological structure. Under such conditions the effectiveness of the most common prospecting methods (reflected waves and common deep point methods) is reduced. The article explains why this is so. The new geological prospecting problems to which the author refers are the following. 1) Exploration of the nonstructural Tyumen' deposits, especially the lithological petroleum traps of the Bazhenovskaya suite. 2) Exploration of the deeply buried Paleozoic complex of Western Siberia, where there are great hopes for significant petroleum finds. 3) Study of regions of Siberia covered with traprocks, which occupy about 70% of the area of Eastern Siberia, highly promising for petroleum and gas. 4) Search for petroleum structures under salt domes. 5) Exploration of reef-formation structures in the inner part of the Russian platform -- domes with rough arches diffusely scattering the energy of reflected waves. 6) In the Volga-Ural petroleum province, search for gently dipping structures with a small amplitude of rising of the top of the arch; structures with an amplitude of 20-30 m are of importance. 7) Increasing the effectiveness of methods of ore

seismic prospecting. Faced with the need for solving such problems, there has been intensive study of direct and inverse kinematic and dynamic problems in seismics for two- and three-dimensional models of media. Numerical methods have been developed for an approximate solution of such problems, on the basis of which a number of mathematical models of the method of three-dimensional seismic exploration for complex media have been developed. The test modeling of this method, carried out using a large series of numerical models of three-dimensional geological objects, reveals considerable possibilities of the method in increasing resolution and broadening the class of determined geometrical and physical characteristics of such objects. The use of algorithms and computers in this work is discussed. The combining of seismic and gravimetric prospecting affords additional possibilities; the same is true of the combining of seismic and electromagnetic prospecting methods. The new geological prospecting problems can doubtlessly be solved by the three-dimensional dynamic seismic prospecting method with areal observation systems and interpretation programs on the basis of the methods of continuation of the wave field and its visualization, the methods of seismic photography, seismic holography and numerical solution of inverse dynamic problems. However, serious problems exist and must be solved; these are discussed and practical recommendations are given. Figures 1.
[26-5303]

UDC 550.34

TECHNIQUE OF VIBRATIONAL PROBING OF THE EARTH

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 7, 1980 pp 28-36

NIKOLAYEV, A. V., doctor of physical and mathematical sciences, RYASHENTSEV, G. I., doctor of technical sciences, CHICHININ, I. S., doctor of physical and mathematical sciences

[Abstract] In the vibrational probing of the earth use is made of relatively low-power, long-acting seismic sources -- mechanical vibrators -- for probing the deep layers of the planet: crust, mantle and core. At the ground surface there is a low-power source of seismic oscillations emitting a harmonic or frequency-modulated signal. Passing through the earth, this signal is registered by a seismic detector and then by a special processing method it is compressed and transformed into a short seismic signal, but of a great amplitude. This signal can be discriminated against a background of microseismic wave noise. The objective of vibrational probing is a marked increase in the detail and reliability of investigation of the deep layers of the earth using new equipment and radiation methods, reception of oscillations and organization of dense observation systems. The theoretical and experimental principles of the new methods have already been developed but their introduction requires the technical reoutfitting of seismology. One of these methods is seismic holography, by means of which it is possible to investigate discontinuities of complex configuration, dislocations and outlines of inclusions. The method can be employed in exploration for minerals. All this will make it possible to solve problems which are completely new in seismology. Systematic probings of the medium will make it possible to detect temporal changes in its elastic properties associated with geological processes and preparation of large earthquakes. This method is,

however, still in the initial stage of its development. Seismic exploration is using mobile hydraulic vibrators developing a force up to 12 tons at frequencies from 10 to 100 Hz. Vibrators for probing the earth must develop a still greater force, tens of thousands of tons, at relatively low frequencies of 1-10 Hz. Such a seismic vibration apparatus can be constructed on different operating principles. The two principal types of sources have a reactive mass, or on the other hand, without a reactive mass. Vibrational or pulsed sources can be employed. One of the promising sources for study of great depths is the pneumatic source. This source is a chamber into which air is compressed under a pressure of 100-150 atm. The chamber is placed in water at a depth of 10-15 m. With the opening of a valve the air is expelled into the water, a shock is created, in turn creating an elastic seismic wave which travels through the water layer. This article discusses such a source which was tested by specialists of the Institute of Physics of the Earth and the Institute of Seismic Resistant Construction and Seismology Tadzhik Academy of Sciences. In general, research shows that vibrators developing a force of several tens of tons and a seismic power of about 10 W at a frequency of about 3 Hz can be used in solving a number of regional problems: study of structure of the crust and upper mantle, carrying out regime observations for the purpose of monitoring the state of the medium, detection of anomalies of wave propagation velocity associated with lunar-solar tidal deformations and redistribution of stresses which are caused by geotectonic processes. A vibrating apparatus corresponding to these characteristics has been created in the Siberian Department USSR Academy of Sciences; this is briefly described. The general prospects for the method are discussed. Figures 6. [26-5303]

UDC 551.510.61

SIMPLE MODEL FOR COMPUTING TURBULENT NOISE IN OPTICAL SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 10, 1980 pp 1107-1111 manuscript received 6 Jul 79

GRACHEVA, M. Ye., GURVICH, A. S., Institute of Atmospheric Physics USSR Academy of Sciences

[Abstract] In designing optical systems operating in the atmosphere it is necessary to take into account the influence of turbulent fluctuations of the refractive index of air on the quality of their operation. The following extreme cases are possible: atmospheric turbulence exerts no influence on operation of the system or the requirements on the apparatus are so high that the influence of turbulence must be taken into account in all cases. In addition, it is necessary to know the anticipated order of magnitude of turbulent noise in an intermediate case. In order to solve these problems it is necessary to have information on atmospheric turbulence and know the altitudinal dependence of the structural characteristic of the refractive index of air $C_n^2(z)$ characterizing the intensity of atmospheric turbulence. In contrast to the well-studied surface layer, little is known concerning turbulence in the free atmosphere. Models of the $C_n^2(z)$ profile proposed earlier are either complex or contain too many undetermined parameters. Moreover, these profiles obtained at one measurement site vary appreciably even over the course of an hour, and therefore the authors propose the use of mean, rather than instantaneous profiles. Accordingly, the article gives a simple model of the dependence of the structural characteristic of the atmospheric refractive index C_n^2 on altitude for the lower 20-km atmospheric layer. Formulas are derived for describing the best conditions, worst conditions and intermediate (average) conditions. The influence of atmospheric turbulence on the optical transfer function and the radius of coherence of the atmosphere-receiving unit optical system is determined by a single parameter, specifically, the C_n^2 value. The use of the tabulated values make it possible to compute the influence of turbulent noise on the operation of optical systems with an arbitrary arrangement of the light source and detector. Figures 2, tables 2; references 21: 6 Russian, 15 Western.
[24-5303]

UDC 551.521.3:551.510.4:551.508.9

INVESTIGATION OF OPTICAL PARAMETERS OF AEROSOL BY THE OPTICAL-ACOUSTICAL SPECTROSCOPY METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 10, 1980 pp 1111-1114 manuscript submitted 14 Jun 79

DUGIN, V. P., TOROPKOV, Yu. G.

[Abstract] One of the fundamental problems in investigating atmospheric aerosol is the development of apparatus by means of which it is possible to make separate measurements of scattering σ (with an integrating nephelometer) and absorption χ (with a spectrophone). Spectrophones can also be used in investigating the coefficients of absorption by atmospheric particles. The optical-acoustical method combines optical simplicity and high response with the advantage of simplicity in processing data. This article gives a detailed description of the optical system for a spectrophone for measuring the coefficients of attenuation α and absorption χ of an aerosol (Fig. 1 in the text is a block diagram of the spectrophone with 16 components identified). The structure and functioning of the instrument are discussed. With respect to calibration, it is shown that the use of gases for this purpose is characterized by a whole series of deficiencies and therefore the use of a filament is proposed for this purpose. The method for making measurements is also fully described. In addition to measurements of the numerical value of the aerosol absorption coefficient, the optical-acoustical method makes it possible to monitor the dispersion of the aerosol in dependence on different experimental conditions. Although the data published in the paper are preliminary, they convincingly confirm the possibility and timeliness of use of an optical-acoustical detector for investigation of the coefficient of absorption of aerosols. Figures 2; references 11: 2 Russian, 9 Western.
[24-5303]

UDC 551.551.2

USE OF THE KAZANSKIY-MONIN THEORY IN ATMOSPHERIC BOUNDARY LAYER MODELS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 787-792 manuscript submitted 5 Apr 79

NATANZON, G. A., TOLOKNOVA, T. A., Leningrad Hydrometeorological Institute

[Abstract] One of the problems of semi-empirical models of a horizontally uniform atmospheric boundary layer is that the lower boundary conditions must be formulated in the region where the equations themselves are already inapplicable. In actuality, at altitudes comparable to the mean altitude h_0 of the irregularities the flow can no longer be considered horizontally uniform, still lower there is a region of intermittent turbulence, and finally, a viscous sublayer. The lower boundary conditions must be formulated applicable to equations describing a horizontally uniform well-developed turbulent flow. This difficulty, as shown in this paper, can be avoided if it is not the Keller-Friedman equations themselves which are considered,

but their asymptotic limit with $Re \to \infty$. It is important that after proceeding to the limit the solutions of the Keller-Friedman equations do not satisfy all the initial boundary conditions. Moreover, a whole series of characteristics obtained from solution of the limiting system of equations increases in absolute value without limits with approach to the underlying surface. The authors here present in detail an algorithm which makes it possible to discriminate the mentioned characteristics in explicit form in the numerical solution of the equations; this does away with the need for having a finer working grid in the neighborhood of the singularity. Figures 1; references 27: 13 Russian, 14 Western.
[18-5303]

UDC 551.551.2:535.311

OPTICAL MEASUREMENTS OF PROFILES OF FLUCTUATIONS OF THE ATMOSPHERIC REFRACTIVE INDEX UNDER MOUNTAINOUS CONDITIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 857-861 manuscript submitted 28 May 79

VORONOYEV, V. V., GOMBOYEV, N. Ts., ZUBRITSKIY, E. V., Institute of Natural Sciences Buryatskiy Affiliate Siberian Department USSR Academy of Sciences

[Abstract] The authors used the optical method in investigating temporal variations of the vertical profiles $C_n^2(h)$ in the lower 200-m layer of the atmosphere in mountainous terrain. Under such conditions the optical method has definite advantages because mountain obstacles, considerably hindering aircraft measurements, in optical measurements can be used for the placement of light sources (reflectors) at different elevations. In optical measurements it is possible to make simultaneous determinations of the C_n^2 parameter at different elevations above the earth's surface. The measurements were made by the method of slant and horizontal (at different levels) probing of the atmospheric surface layer by coherent optical radiation. Investigations along slant paths were made around-the-clock in a closed mountain basin in the Ulan-Ude region along paths with lengths of 3.75, 5.1 and 6.4 km and the maximum distances of the rays from the underlying surface were 20, 120 and 240 m. The results of this experiment indicated that the temporal changes in the structural characteristic are an essentially nonstationary random process in which rapid temporal variations with a time-variable dispersion are superposed on the diurnal variation of the mean value. The noncoincidence of the C_n^2 values measured simultaneously on three paths is evidence of a dependence of the structural characteristic on altitude above the underlying surface. All values of the structural characteristic C_n^2 were broken down into two groups: daytime and nighttime. The scatter of C_n^2 values at all heights was greater during the daytime than at nighttime. The diurnal variation of C_n^2 were more clearly expressed on horizontal paths than on slant paths. The dispersion of the temporal changes in C_n^2 decreases with height and during the daytime is considerably greater than at nighttime. Figures 4; references 16: 14 Russian, 2 Western.
[18-5303]

UDC 551.521.3:551.576:621.375.826

DETERMINATION OF THE SCATTERING COEFFICIENT IN CLOUDS FROM MEASUREMENT OF A REFLECTED LASER PULSE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 867-871 manuscript submitted 1 Mar 79, resubmitted after revision 1 Oct 79

GORODETSKIY, A. K., GOL'DIN, Yu. A., KNYAZEV, N. A., MALKOVA, V. S., SHVOM, Ye. M., Institute of Oceanology USSR Academy of Sciences

[Abstract] The sounding of clouds with the use of pulsed lasers makes it possible to judge the macrostructure and optical characteristics of the cloud layer. The decay of the backscattering pulse is used in determining the scattering coefficient. The authors studied backscattering pulses obtained in sounding cumulus clouds from an IL-14 aircraft in a horizontal direction. The pulsed laser used operated at a wavelength of 0.53μm with a pulse duration of 15 nsec and a beam divergence of 20'. The detector had a field of view of 1.5° and signal registry was on photofilm. The matching of decays of backscattering pulses characterizing a single-mode distribution with a monotonic signal decrease is indicative of the practical possibility of representation of the backscattering pulses received from dense water-droplet cumulus clouds as a function of a dimensionless variable. The matching of the pulse decays is at the decay level 0.1 N_{max}, which corresponds to an optical thickness $\tau \simeq 2.6$. Figures 1; references 12: 9 Russian, 3 Western.
[18-5303]

UDC 551.521.3

SPECTRAL INVESTIGATIONS OF ABSORPTION OF SOLAR RADIATION BY NATURAL AEROSOL

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 8, 1980 pp 869-871 manuscript submitted 21 May 79

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[Abstract] In order to ascertain the desired characteristics of aerosol absorption the authors made appropriate spectral measurements of direct and scattered solar radiation and also albedo of the underlying surface in individual sectors of wavelengths with λ_{max} = 0.447, 0.547, 0.650, 0.70, 0.74, 0.85, 1.01μm. Two instruments were used: a visual electrophotometer with interference light filters with a transmission half-width at the 0.5 level not greater than 0.01μm and an IR electrophotometer, constructed on the basis of a monochromator, with a spectral slit width of less than 0.01μm. The albedo of the underlying surface was determined using these same instruments and an integrating photometric sphere and on the basis of polarization measurements of skylight. The agreement of the data obtained by these independent methods made it possible to consider the underlying surface homogeneous over a considerable area. All the data were collected in the semidesert of Southern

Kazakhstan. An expression was derived for determining the aerosol optical thickness of extinction ($\tau_a^{abs} + \tau_a^{sc}$). In order to find the component τ_a^{abs} it is necessary to find the optical thickness of scattering on the basis of measurements of scattered radiation. This problem is highly complex because it involves determination of light multiply scattered and reflected from the underlying surface. The method for determining absorption by a natural aerosol is described in detail. The spectral dependence of aerosol absorption was determined for large and small optical thicknesses. A table gives the mean values of aerosol absorption and the corresponding standard deviations and also the mean relative humidities measured at the earth's surface, the total content of water vapor in the entire column of the atmosphere and the limits of their change. Data for great optical thicknesses were obtained on the basis of 13-15 records for each of the considered wavelengths and for small optical thicknesses on the basis of 25-30 records for each wavelength. Figures 2, tables 1; references: 5 Russian.
[18-5303]

MISCELLANEOUS

SOVIET ANTARCTIC EXPEDITION LEADER OUTLINES PROGRAM

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[Interview with V.I. Serdyukov, leader of 26th Soviet Antarctic Expedition, correspondent T. Chesanova: "Antarctica-Bound"; date not specified]

[Text] Within the next few days the first ships of the 26th Soviet Antarctic Expedition Flotilla--the Ms Bashkiriya from Odessa and the diesel-powered Kapitan Markov from Leningrad--will be setting off for the shores of the sixth continent on a long-distance voyage lasting from fall through spring. A large party of Soviet polar explorers will continue the comprehensive study of our planet's south polar region. Leader of the 26th Soviet Antarctic expedition, experienced polar researcher V.I. Serdyukov, discusses the coming scientific vigil on the world's harshest continent with our correspondent T. Chesanova:

Comprehensive observations of weather and ice conditions in the Antarctic Ocean will be continued at seven Soviet Antarctic stations. The 26th Soviet Antarctic expedition scientific program, like that of its predecessors, includes all manner of research: aerometeorological, geophysical, glaciological, hydrological, geodesic, biomedical and more besides. This work should yield important results both for solving global earth science problems and for the practical purposes of safeguarding navigation along Antarctica's coastline and flights into the continent's interior.

It is planned to increase the number of environmental experiments in the vicinity of the Mirnyy observatory.

A particularly large group of operations will, as usual, be carried out in the summer period. Geologists, geophysicists, topographers and geodesists will continue investigations on the Filchner glacier and the adjacent mountain ranges. Provision has been made for establishing "Druzhnaya-2"--a new seasonal base from which to carry out research in West Antarctica--on the Ronne Iceshelf at the base of the Antarctic peninsula in the southwest of the Weddell Sea.

The members of three scientific expeditions into the continent's interior--in the direction of the South Magnetic Pole and in the vicinity of the Komsomolskaya Sovetskaya stations--will be working under formidable conditions. I would like to point out that while in the first stage of the study of the mysterious icy continent virtually every step taken by the scientist was a discovery, since just 2 decades ago this was all an enigma, the second stage was characterized by

deeper and more systematic research in a number of avenues. Soviet scientists have now begun the next stage of their work, on the basis of large independent programs which in most cases are elaborated in collaboration with experts from other countries.

One such program--the International Glaciological Program--is, for example, devoted to the study of Antarctica's icecap. Under this program observations will also be carried out during scientific expeditions covering a total of 5,000 km. In addition, drilling into the ice cap in order to study the structure of the ice and the processes taking place in it will be continued at the Vostok and Komsomolskaya stations.

In accordance with the plan for international cooperation Soviet scientists will work together with colleagues from the GDR, Japan and Australia at various stations and on trans-Antarctic expeditions. Work will continue at the Molodezhnaya Meteorological Center on the construction of an airport complex for heavy aircraft with wheeled undercarriages. Survey work will begin on the construction of mooring facilities at Mirnyy and Molodezhnaya.

Expedition ships, including the "Professor Zubov" and "Professor Vize" scientific ships, will once again operate in the Antarctic Ocean in accordance with the "Polar Experiment South" program. Carrying out aerological observations and hydrological surveys and siting drifting meteorological buoys and underwater buoy stations are just a few of the marine operations which will be carried out within the framework of the 26th Soviet Antarctic expedition.

This time a total of eight ships flying the Soviet flag will be setting off for the shores of Antarctica at different stages of the expedition. They will carry more than 600 Soviet polar explorers to the sixth continent, half of whom will spend the winter there.
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